Managing Congestion and Reducing CO_2 and Pollutant Emissions

The Broad Outlines of a Plan for Managing Congestion and Reducing CO_2 and Pollutant Emissions in Alameda County

by

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Executive Summary

This report examines the long-term trends of commuting in Alameda County by transit and highway. It finds that the number of motor vehicles registered in the county increased from 462 per 1000 residents in 1960 to 814 per 1000 residents in the year 2000—an increase of 76 percent over 40 years. This increase in motor vehicle ownership occured despite one of the nation's most aggressive efforts to encourage transit use and ridesharing.

Thanks to a succession of major funding commitments, transit has been able to maintain a commute share of 10 percent or a little higher since 1960. The stabilization of transit's commute share in Alameda County compares favorably with the trend of transit's commute share in the Bay Area as a whole which declined from 15.4 percent of all commute trips in 1960 to 9.8 percent of all commute trips in 2005, due primarily to rising incomes, increasing motor-vehicle ownership, highway improvement and the increasing share of metropolitan commuters that live and work in outlying suburbs.

Other commute alternatives such as carpooling, vanpooling, walking and bicycling have not faired as well. The share of Alameda County commuters that rely on these "other commute alternatives" declined by 28.6 percent from 1980 to 2005, while transit's commute share declined only 15.2 percent from 1980 to 2005. (In both cases, the decline since 1980 was statistically exaggerated by the ridership peak that occured during the Iran-Iraq war of 1979-80.)

With transit's nine-county commute share in decline, MTC and ABAG have turned to Transit-Oriented Development as the most promising regional strategy for achieving a next generation of gains in transit use. We concur that transit-oriented development has the potential to substantially increase transit's daily ridership, but think it is unlikely that transit-oriented development can increase transit's Alameda County commute share by much more than two percentage points by 2020. A two percentage point increase in transit's commute share would be larger than any transit achieved during the entire period 1960 through 2005—with the exception of the surge in commute share that accompanied the fuel-price surge 1979-80.

Smart Growth notwithstanding, we expect suburban population and employment growth will continue to exceed urban population and employment growth in Alameda County—driven by continuing employment growth in East and South County. This will produce a difficult test for BART-focused transit-oriented development, because proximity argues that it will be easier for many TOD residents to drive to work locally than ride BART or the bus. Thus, we anticipate a smaller increase in transit commuting than MTC and ABAG are anticipating and a larger increase in VMT, congestion, automotive pollution and CO_2 emissions.

Based on the likely difficulty of building transit's market share in the face of continuing suburban employment growth, it may be appropriate for Alameda County and the wider Bay Area to consider a regional fuel surtax of Canadian magnitude (roughly fifty cents higher than present California fuel taxes). This would provide increased incentive for transit use, ridesharing and the purchase of fuel-efficient vehicles. *To*

preserve the buying power of Bay Area households, it would be essential that any such fuel surtax be paired with a counterbalancing reduction in sales or income taxes. In other words, what we are proposing is a tax *swap* rather than a tax *increase*.

Introduction

This report examines the contribution that motor vehicles make to air pollution and greenhouse gas emissions in Alameda County and the nine-county Bay Area. It also examines the magnitude of the combined contribution that transit and transit-oriented development could make in mitigating congestion, automotive pollution and CO2 emissions.

We will begin with a brief appraisal of Alameda County's long-standing efforts to improve public transportation, increase transit use and promote ridesharing, then turn to an appraisal of present regional efforts to contain sprawl, encourage infill and promote transit-oriented development. We will close with the broad outlines of a plan to reduce congestion, automotive emissions and the contribution of motor vehicles to global warming.

The Facts on the Ground

Judging by the share of Bay Area workers that commute by transit, our region is the nation's third-most transit-oriented metropolitan area. The Bay Area is also the nation's fourth most-congested metropolitan area. Thanks to its central location, Alameda County is the Bay Area's most-congested county, its second most dominant transit market and the region's principal trucking and distribution center. The level of transit use and the intensity of congestion both reflect Alameda County's relatively high density, its central location, and the resulting volumes of both local and pass-through traffic that use its freeways for commuting and goods movement. This concentration of traffic and congestion is most clearly evident in the daily number of commuters and truckers that use I-80, 238, 580, 680, 880 and 980.

Table 1 on the page facing summarizes the most recent data available for assessing the status and the performance of Alameda County's transportation system. It reports that the time wasted due to freeway congestion in Alameda County has more than doubled in the 15 years since 1992. It also reports that there has been a significant increase in the fuel consumption associated with stop-and-start driving and congestion-related delays. Increased congestion has also increased vehicular emissions. Indeed, congestion now accounts for a significant share of the time spent on the road and a significant additional increment of CO2 and conventional pollutant emissions.

In the pages that follow, we will examine what reduction of traffic growth and congestion we can expect from ongoing transit improvement and Smart Growth—and, in turn, what contribution they can be expected to make to the reduction of CO2 emissions. Table 1 provides the context necessary for this analysis. The implication of Table 1 is that Smart Growth paired with an aggressive program of transit improvement is unlikely to prove sufficient to substantially reduce either CO2 emissions or congestion unless the Bay Area can achieve simultaneous reductions in the vehicle miles and vehicle hours of travel associated with continuing population and employment growth and increasing congestion. No present plan contemplates reductions in VMT or congestion sufficient to achieve such outcomes.

Table 1: Sizing Up The Bay Area's Transportation Problems

Congestion

The Bay Area is one of the nation's four most-congested metropolitan areas (1).

Congestion accounted for an estimated 60 hours of delay and 47 gallons of wasted fuel per traveler in the Bay Area last year. Los Angeles is the only U.S. metropolitan area that had more congestion. Atlanta and Washington, D.C. shared second place with the Bay Area.

Six of the Bay Area's 10-most congested freeways cross Alameda County. Together, they accounted for 39 percent of the region's freeway congestion (2).

The concentration of both freeway traffic and freeway congestion in Alameda County reflects our county's central location, the large volumes of pass-through traffic that use our freeways and the county's regionally dominant role in shipping, trucking and goods movement. The intensity of Alameda County freeway congestion also reflects the delay that occurs at regional gateways such as the three bay bridges, the Caldecott Tunnel, the Dublin Grade, the Altamont Pass and the Dublin Grade.

The time wasted due to freeway congestion in Alameda County has more than doubled since 1992. This has produced a paired increase in the fuel consumption associated with stop-and-start driving.

Registered Vehicles and Vehicle Miles of Travel (VMT)

The number of motor vehicles registered in Alameda County increased 180 percent from 1960 to 2000, while the number of vehicles per 1000 population increased 76 percent.

Bay Area VMT has more than doubled since 1980 (3).

Vehicle travel on highways and freeways in Alameda County accounted for 21 percent of the VMT logged on Bay Area freeways in 2005—a VMT share closely equivalent to the county's 20 percent share of Bay Area employment.

Air Pollution and Carbon Dioxide Emissions

Motor vehicles accounted for 65 percent of the Bay Area's carbon monoxide emissions, 51 percent of its nitrogen oxide emissions and 36 percent of its reactive organic gases in 2006 (4).

Highway transportation also accounted for 44 percent of the Bay Area's greenhouse gas emissions in 2006. Despite their ubiquity, passenger cars and light-duty trucks accounted for only 30 percent of all Bay Area greenhouse gas emissions, while heavy trucks accounted for 14 percent (5).

The Bay Area Air Quality Management District has estimated that Alameda County accounts for 17 percent of the Bay Area's total CO_2-equivalent greenhouse gas emissions. Transportation, including aviation, accounts for 47 percent of the County's greenhouse gas emissions—a larger share than in other counties(6).

What Can We Expect from Transit?

If Alameda County is to successfully reduce both congestion and CO_2 emissions at the same time, it will be necessary for transit to achieve substantially higher rates of commuter ridership than it serves at present without relying on increasing congestion to provide the modal advantage it needs to do so. It will also be necessary for our freeways to operate more efficiently during peak commute hours, that is, with less prolonged congestion and less stop-and-start driving, both of which produce excess CO_2 and pollutant emissions. This is a formidable dual challenge, and it is appropriate to begin by addressing the question: What are our prospects for success?

The good news is that Alameda County has been a pioneer in public financing of public transportation which has enabled it to sustain a transit commute share of 10 per cent or a little higher during the entire forty-five year period from 1960 to 2005 as shown in Table 2. The same table also shows that the Bay Area as a whole has been unable to sustain and stabilize transit's commute share as effectively as Alameda County. But even Alameda County has been unable to achieve any sustained *increase* in transit's commute share. In the pages that follow, we will examine why transit has been unable to build commute share in Alameda County and why other commute alternatives have actually lost market share to the automobile and passenger trucks.

Table 2:

Transit Commute Shares in Alameda County and the Bay Area: 1960-2005

	Alameda County	The Bay Area
1960	10.6%	15.4%
1970	10.6	11.3
1980	12.5	11.4
1990	10.0	9.5
2000	10.6	9.7
2005	10.5	9.8

Source: U.S. Census, "Journey to Work" files 1960 to 2000, and MTC/ABAG, "Bay Area Census, 2005."

The remarkable stability of transit's commute share

What did it take to stabilize transit's commute share in Alameda County over the past 45 plus years since 1960? The answer is that it took a major new financial and programmatic commitment to transit each and every decade from 1960 to present. We will recount this history in some detail because it illuminates both the difficulty and the cost that are likely to be involved in achieving future gains in transit's commute share.

In the 'Sixties, Alameda County became one of the first counties in California to use property taxes to acquire its local transit system—AC Transit—and convert it from private to public ownership. In turn, local taxpayers paid to modernize the former Key System's fleet of buses and provide the operating dollars to reduce transit fares. Public ownership and federal investment in AC Transit served to in stabilize transit's Alameda County commute share at 10.6 percent of all commute trips.

Step two followed in the 'Seventies when the California legislature committed the state to provide sale-tax subsidies for transit operating purposes. That same decade Alameda County voted its support for the three-county property tax necessary to build the BART system (7). The combined effects of BART implementation, sales-tax funding of transit operations, continuing expansion of AC bus service, and, the OPEC Oil Embargo were sufficient to neutralize the impact of the Interstate Highway Program on transit's commute share. In fact, transit's Alameda-County commute share reached a post-1960 high of 12.5 percent in 1979, thanks to the OPEC Embargo. With the benefit of hindsight, we now know that 1979 and 1980 were peak years for transit's post-1960 commute share in Alameda County (8).

From 1980 to 1990, the effects of continuing motorization and suburban growth were temporarily dampened by the Iran-Iraq war and the renewed volatility of oil prices in the Middle East. In Alameda County, BART service was extended to Dublin and local bus and paratransit service was inaugurated in the Livermore-Amador Valley. Perhaps more important, women's labor force participation continued to increase. This had special significance for transit because 12 percent of female workers in Alameda County used transit for their journey to work by 1990, compared to only 8.4 percent of their male counterparts (9). Thus, increasing women's labor-force participation served to buoy up transit commuting in Alameda County. This powerful social dynamic combined with continuing transit improvement to sustain Alameda County's transit commute share at 10.0 percent through 1990. In the 'Nineties, increasing congestion and path-breaking federal legislation—ISTEA and TEA-21—provided the incentive and the next increment of federal funding necessary to restore transit's Alameda County commute share to 10.6 percent—just where it stood in 1960. In 2005, it retreated to 10.5 percent—a decline but not a statistically meaningful one.

The implication of this analysis is that Alameda County was able to build transit ridership and sustain transit's commute share because it was willing to make one of the nation's most aggressive commitments to transit investment and subsidy. Other powerful social dynamics—income growth and suburban population and employment growth—combined with the Interstate Highway Program to fuel the countervailing increases in automobile ownership that are shown in Table 3 on the next page. It shows that motor vehicle ownership in Alameda County increased from 420 motor vehicles per 1000 population in 1960 to 814 motor vehicles per 1000 population in 2000. The net result was essentially a stalemate for transit: Sustained investment and operating subsidies have increased transit's ridership but have produced no sustained decade-to-decade increase in transit's commute share. This should not be surprising: Suburban population and employment growth accounted for most of the population and employment growth that occured in Alameda County from 1960 to 2005.

Table 3:

Motor Vehicles per 1000 Population in Alameda County in 1960 and 2000

	1960	2000	Percent Change
Registered vehicles (in thousands)	419.9	1175.5	+180 %
Population (in thousands)	908.2	1,443.7	+59 %
Vehicles per 1000 population	462	814	+76 %

Source: Decennial Census and California Department of Motor Vehicles

Suburbanization and the Intensity of Motorization in Alameda County

Table 4 on the next page itemizes the primary reasons that suburbs which grew up with the automobile after World War II have proved an inhospitable environment for transit use. As it indicates, relatively low population density and sparse transit service are only two of many factors that account for transit's limited ridership and diminished commute share in suburban settings. Density is a factor that Smart Growth can, at least partially offset—but the other factors are more problematic. They include the present intensity of motor vehicle ownership, the present dispersion of metropolitan worksites, the segregation of residential and commercial land-uses, the prevelence of free parking and the complex schedules and itineraries of households with children. These factors contributed significantly to the intensity of year 2000 motorization shown in Table 3 above and the decline in transit's nine-county commute share shown in Table 2.

As this discussion suggests, Alameda County has made a serial commitment to funding major transit investment. This has successfully sustained transit commuting in the face of motorization, freeway development, suburbanization, increasing household incomes and an increasing share of households with two and three vehicles. Absent such a commitment, transit's Alameda County trajectory might well have followed a path more like that which Table 2 showed for the Bay Area as whole. Instead, stabilization was achieved, but at the cost of steadily increasing expenditure.

The implication for the future is that substantially more expenditure will be necessary if we expect transit to make any substantially greater contribution to the reduction of congestion, pollution and CO_2 emissions in the years ahead.

Table 4: Why Suburbs are an Inhospitable Market for Mass Transit

1. Most Americans that live in suburban households have the income and borrowing power to afford both home and automobile ownership. Once households have made the financial commitment to own an automobile, the marginal cost of using it is relatively small.

2. Households with children are the norm for most suburban communities. Such households have complex schedules and itineraries that transit cannot serve conveniently given the land-use arrangements characteristic of suburbs built since World War II.

3. The planned characteristics of suburbs include: Ample off-street parking, the segregation of residential and commercial land uses and the design and engineering of neighborhood streets to prevent the intrusion of cross-town traffic in residential areas. The intended result is a community of quiet neighborhoods compatible with the safe and convenient use of the automobile. The unintended result is an environment inhospitable for walking and transit use.

4. The characteristic suburban housing type is single-family detached. Most communities of single-family homes sized to meet the expectations of middle-class families lack the density that is needed to support frequent arterial bus service.

5. Auto use is an accustomed part of the suburban life-style. It is the way most suburban residents get to work, get to school, raise children, socialize and take vacations. In other words, auto use has become a suburban norm as well as a mode choice.

6. Most suburban residents work locally or in another suburb nearby. This makes it virtually impossible for transit to compete with the automobile for local or suburb-to-suburb commuting because suburban destinations are dispersed, most parking is free and most local transit service is infrequent.

7. Even where suburban transit is well-patronized for getting to work, almost all off-peak and weekend trips are made in personally-owned vehicles.

8. For all of the reasons above, suburban ridership is usually insufficient to justify frequent local service—which poses yet another obstacle to suburban transit use.

Source: David W. Jones, *Mass Motorization and Mass Transit,* Indiana University Press, 2008.

What Can We Expect from "Other Commute Alternatives?"

Table 5 shows the usage trend of commute alternatives other than transit in Alameda County. These "other commute alternatives" include carpooling, bicycling, walking and working at home. The table shows that every commute alternative but working at home *lost* commute share from 1980 to 2005 in Alameda County. Carpooling posted a commute share gain for the year 2000, but its 25-year trend for the overall period 1980 to 2005 was downward.

Table 5: The Share of Alameda County Commuters Using "Other Commute Alternatives"

	1980	1990	2000	2005	Percent Change
Carpooling	16.0%	12.8%	13.8%	11.1%	-31%
Walking	4.8	4.0	3.2	2.9	-40%
Bicycling	3.4	2.6	1.2	.9	-74%
Working at home	1.7	3.9	3.5	3.6	+112%
"Other" total	25.9	23.3	21.7	18.5	-28.6%

Source: U.S. Census, "Journey to Work" files 1980 through 2000 and MTC's year 2005 Bay Area Survey

As Table 5 indicates, walking to work, commuting by bicycle and carpooling now serve relatively small cohorts of the working population, and these cohorts have shrunk significantly in percentage terms since 1980. On the other hand, "other commute alternatives," taken together, still accounted for 18.5 percent of all work trips made or avoided in 2005. Thus, like transit, "other commute alternatives" still make a significant collective contribution to providing mobility, reducing cold-start emissions, CO_2 emissions and conserving parking space, but, their ability to make any substantially larger contribution to the reduction of congestion, pollution and CO_2 emissions, will hinge on reversing the 25-year down-trend of their commute shares.

The implication of Tables 2, 4 and 5 is that neither transit nor any other commute alternative has been able to *build* commute share despite the major financial commitment that has been made to sustaining transit use and the extensive effort made by Rides, employers, ridesharing brokers and broadcasters to encourage both transit use and ridesharing in the face of suburbanization and motorization.

Transit-Oriented Development: The "Next Strategy" for Increasing Transit Use

Faced with the challenges posed by global warming and petroleum dependence, local and regional planners have focused on Transit-Oriented Development as their "next strategy" for sustaining and increasing transit use. Often called Smart Growth, Transit-Oriented Development (TOD) is a land-use planning strategy that seeks to focus housing development in dense clusters in the immediate vicinity of a BART, ACE or commuter-rail station and in appropriate locations along trunk-line bus routes serving major urban boulevards or suburban thoroughfares. In Alameda County, such boulevards and thoroughfares include Telegraph Avenue, San Pablo Avenue, 14th Street, Mission Boulevard, MacArthur, Hesperian, Alvarado, Dublin Boulevard and Hopyard Road. The emissions generated by diesel buses, are sometimes raised as an objection to rapid bus service on major arterials, but this is a problem that can—and should—be corrected by careful selection of bus technologies that are environmentally appropriate for high-frequency service in a densely-settled urban environment. With this caveat about bus technology, Transit-Oriented Development can be broadly defined and described as development of relatively high density located in convenient proximity to a BART, ACE or commuter-rail station, a trunk-line bus route or a major transit transfer center.

The premise of Smart Growth is that higher density housing development located in close proximity to a transit line that provides frequent service will enable and encourage more Alameda County residents to use transit, share rides or walk and bicycle to nearby workplaces in larger numbers. Just as important, it has been well-demonstrated that Transit-Oriented Development can also contribute to increased *off-peak* ridership of transit. This is particularly important because the fares paid by off-peak riders are revenues that transit systems desparately need to sustain weekend and night-time service, finance the replacement of aging equipment and expand peak-hour service.

In Alameda County, with its diverse population, its varied neighborhoods and its range of population densities, it is fitting that different parts of the County arrive at situationally-appropriate definitions of "relatively high density." At the same time, local planning for transit-oriented development has to reflect the basic economic realities of rail transit investment: Station-area development of sufficient density to ensure 5000 daily boardings is essential to assure the Federal Transit Administration that a BART extension will generate sufficient ridership to justify the federal investment necessary to capitalize the extension of a system as costly as BART. A marginally lower threshold applies to a commuter-rail operation. In each case, the CMA is prepared to partner with localities in securing the funding necessary to finance local planning for station-area development.

What are realistic expectations for Transit-Oriented Development?

Transit-Oriented Development has emerged as the most promising "next commitment" that Alameda County and its cities can make to sustain transit's commute share at its present 10.5 percent while making transit access and transit use more convenient for a next generation of new riders who live "just next door" to rail stations, bus transfer centers or heavily used bus routes. In fact, Smart Growth seems to be one of only two initiatives with the potential for increasing transit's countywide commute share

by one or two percentage points beyond its present 10.5 percent commute share. The other promising initiative is a much more controversial one: An increase in fuel taxes—an incentive most economists agree would be necessary to achieve any mode shift to transit larger than one or two percentage points.

The Case for Smart Growth

Using year-2000 data from the Bay Area Travel Survey, the Metropolitan Transportation Commission has evaluated the travel choices made by Bay Area households that live close to transit and their counterparts who live more than half a mile from a bus stop, BART station or commuter rail depot. MTC's analysis indicates that (11):

> Residents living near transit drive less, ride transit more and own fewer cars.

> Compared to the Bay Area at large, Bay Area residents who live within a half-mile radius of a rail station or ferry terminal were:

Three times more likely to use transit

More than twice as likely to commute to work by transit

Three times more likely to bicycle or walk to work

Fifty percent less likely to drive to work.

> Transit ridership is maximized where population density excedes 10,000 persons per square mile

Ridership attenuates with distance from a rail station or ferry terminal

> The location of *both ends* of a commuter's home to work trip influence his or her choice of commute mode.

Excluding the special case of San Francisco, transit is used by nearly one-third of Bay Area workers who live and work within a half-mile radius of a rail station or ferry terminal.

> Commercial activity built into Transit-Oriented Developments can generate high levels of transit ridership by workers employed at businesses located in mixed-use transit-oriented developments.

These results are similar to results this author found in a study of Oakland's Fruitvale Village for the Alameda County Congestion Management Agency (12). Both studies support the conclusion that:

There is a market for affordable housing proximate to transit stations and transit transfer centers located in a centrally-located metropolitan county;

The year-2000 transit use-rates among TOD residents was substantially higher than that of Alameda County residents at large.

But neither the MTC study nor this author's previous work establish the *depth* of the market for transit-oriented development. This author's experience suggests that self-selection is critically important to the decisions made by individuals, couples and families in choosing their place of residence. So far, the Bay Area's experience with the implementation of Transit Oriented Development suggests that there is a market for transit-adjacent housing that is both affordable and located within convenient commuting distance of San Francisco, Oakland and San Jose (13). But, we know little about the depth of that market and very little about the transportation benefits of Transit Oriented Developments located in auto-oriented suburbs a substantial distance from the region's three urban cores. The next generation of transit-oriented developments in Alameda County will provide such information.

TOD Projects in Alameda County

Good examples of transit-oriented development are already in place in Berkeley, Hayward and Oakland and planning for the development of a next generation of TOD projects is underway in the cities of Alameda, Albany, Dublin, Emeryville, Fremont, Newark, San Leandro and Union City (15).

A sticking point for some Alameda County cities seeking regional approvals for TOD projects is that ABAG and MTC are now proposing more housing and substantially higher densities than these cities originally anticipated. These rising thresholds reflect federal targets that have to be met to secure federal funding for transit oriented development. In turn, ABAG and MTC's evolved Smart Growth policies increasingly reflect housing "needs" forecasts that are based on federal mandates and federal transit policies rather than a negotiated consensus between local and regional authorities based on actual growth and location trends. These mandates require ABAG to foster the development of both workforce housing and shopping and employment opportunities in those Bay Area neighborhoods where poverty and joblessness are most acute and to steer employment growth and infill development so as to provide jobs and regenerate urban neighborhoods—both in the central cities and in other parts of the County.

In turn, the station-area densities that ABAG now expects are much greater than those that Alameda County cities were anticipating based on past local experience. This is because ABAG is now practicing indicative planning with a focused emphasis on the use of federal funds to enhance employment opportunities in cities like Oakland and to ensure that the housing provided by Transit-Oriented Development is consonant with the needs of lower-income households. The wedding of planning for Smart Growth with federal housing policy occured during the the back-to-back presidencies of George H. Bush and Bill Clinton. More locally, it also reflects the constituency politics of the Regional Livability Footprint Project and ABAG and MTC's active partnership with the Bay Area Alliance for Sustainable Development.

The evolution of Smart Growth

The initial objective of Smart Growth planning in the Bay Area was to develop or redevelop neighborhoods adjacent to BART stations in ways that would increase the availability and affordability of both owner-occupied and rental housing and provide easy

access to neighborhood shops and services—all within convenient walking distance of a BART or light rail station. The original transportation goals for transit oriented development also included well-coordinated bus-to-BART and bus-to-bus transfer arrangements, combined with street lighting and other street improvements that can make walking safer—even late at night. This original conception of Smart Growth was—in essence—a Bay Area replication of Portland's strategy for Smart Growth.

These elements continue to frame the ABAG and MTC approach to Smart Growth. What has changed is the density of the station-area housing that is now required as a condition of federal funding for rail transit and transit-oriented development. In turn, ABAG is now mandating a half-mile development zone around those BART stations where land-acquisition for large-scale, high-density development or redevelopment is feasible. These mandates reflect the increasing federalization of planning for Smart Growth that occured during the 1990s. In several cases, this has produced considerable friction between local governments, ABAG and MTC.

Most Alameda County cities are supportive of the concept of transit-oriented development, but the density of the station-area housing that ABAG is now advocating is substantially higher than most localities had anticipated. ABAG is also asserting the need for a mix of housing types that matches the spending power of the local workforce—even if it is dubious whether developers can deliver such housing without density allowances much greater than some localities are prepared to accept. In many cases, these localities would be more comfortable with a compact new neighborhood of small shops, townhouses and a still-generous supply of BART parking to accommodate BART riders accustomed to driving to the station. These same localities are now concerned about the balance between tax revenues generated and the services required if the emphasis of Smart Growth shifts further from transit-oriented development to workforce and low-income housing. BART itself is concerned about financing the additional rolling stock that could be necessary to accommodate the additional peak-hour ridership that would be generated if very high densities were to become the station-area norm.

Increased density and congestion

Our contribution to this debate will be an examination of the relationship between density, income, transit use-rates and localized congestion given uncertainty about commuter destinations and transit use rates. We begin with a basic, but largely unexamined issue: Will higher density increase traffic congestion and congestion-related pollution emissions in our cities and on our freeways? Or will it prove sufficiently effective to produce a net reduction in automotive commuting, congestion and congestion-related emissions?

Many advocates of Smart Growth would answer: "Higher density will increase transit use and increased transit use will reduce congestion." But this outcome is conditional and circumstantial. We know this because the residents of Transit-Oriented Developments report widely different reasons for choosing their new condo, townhouse or apartment and actual transit use rates vary substantially from one TOD to the next. Yes, a transit-oriented development may be located so as to enhance the convenience of

transit use. But the buyer of a condo or the renter of an apartment may, in fact, be motivated by affordability—rather than transit accessibility. Alternatively, the choice of this particular residence may reflect the ambition to own a condo or rent an apartment that is "new" or "fresh and clean."

More critically, the location of a commuter's *place of work* plays a decisive role in determining his or her choice of mode. If he or she owns a car and works in a suburban office park where parking is free, there is a good chance he or she will drive to work. For all of these reasons, it is not atypical for drive-alone commuting to exceed transit use among the residents of suburban Transit-Oriented Developments in the Bay Area. A primary reason is the increasing suburbanization of Bay Area employment.

Smart Growth nothwithstandimg, development of suburban density and character is expected to remain the norm for Alameda County—primarily due to the continuing growth of *employment* in Central, Eastern and Southern Alameda County. Indeed, MTC reports that 57 percent of all jobs in Alameda County are now located South of Oakland or East of the Oakland foothills. And this share is expected to exceed 60 percent by 2030 (16). In other words, the geographic trend of employment growth in Alameda County is expected to be continuing suburbanization—Smart Growth notwithstanding.

In the context of these cross-currents, the transit ridership, congestion and emissions impacts of Smart Growth are difficult to anticipate and forecast accurately. The expectation of Smart Growth advocates is that Smart Growth will increase transit use and thus reduce congestion relative to the proverbial "do nothing alternative." Indeed, MTC and ABAG's forecasts for Smart Growth imply the expection of a near-50 percent increase in transit commuting in Alameda County. But Smart Growth of the density that ABAG is proposing under federal mandate will also tend to focus residential development and concentrate traffic flows. In turn, Smart Growth is likely to produce *more* congestion and *more* fuel consumption due to increased *concentration* of traffic. The *actual outcome* will hinge on the *actual workplace destinations* to which TOD residents commute, the availability of free parking at their workplace and the actual mode choices that TOD residents make, given where they live, where they work and whether they own a car.

Smart Growth is most likely to reduce congestion if a significant number of TOD residents *work* in a dense, central-city setting where the cost and limited availability of parking provide significant incentive for transit use. This same outcome is much less likely to be achieved by a TOD whose residents work in a suburb where local transit service is limited and parking is both free and plentiful. In other words, the effectiveness of Transit Oriented Development as a trip-reduction, emissions-reduction and congestion-management measure is likely to hinge on present unknowns: Where its residents will work, how many of these future residents can get to work conveniently by transit and how many have a car and could park free if they choose to drive to work.

Is this uncertainty problematic? Evidence from Portland, Oregon—the birthplace of Smart Growth and Transit Oriented Development—suggests that it could be. In Portland, planners executed what seemed a textbook-perfect plan for Smart Growth. Portland's plan included the financing and development of a regional light-rail transit

system, the concentration of apartment and townhouse development in the vicinity of rail stations, increased density allowances for commercial buildings built downtown and an urban limit line to prevent premature development of outlying open space. Highway investment was deferred to secure the local match for the light rail system and a highly effective plan for bus-to-rail and bus-to-bus transfers was implemented at light rail stations.

One result was a significant increase in transit ridership: 56 percent over the first decade of light-rail operation. Another was a 26 percent increase in ridership per capita and a 21 percent increase in transit's commute share. Bicycle commuting also increased simultaneously. So far so good: But the *actual* increase in transit's commute share from 1990 to 2000 was from 4.7 percent to 5.7 percent—an increase of only one percentage point on a relatively low base (17).

In order to finance light-rail investment Portland had to swap highway funds for transit funds. With highway investment deferred and its dot.com boom in progress, Portland experienced the largest increase in highway congestion of any city in its size class. It also experienced an estimated increase of 283 percent in congestion-related fuel consumption (18). Both were unanticipated outcomes that essentially negated the energy savings and emissions benefits that Portland expected to achieve from Smart Growth. Alameda County could experience much the same outcome given the suburban locus of much of its projected future employment growth.

The lesson to be learned is that growth of any kind—Smart or otherwise—can increase traffic and congestion. In turn, increased congestion will make it harder to realize the air-quality, CO_2 emissions-reduction, and, fuel-conservation benefits expected of transit-oriented development. Given the size and the density of the housing increment that federal authorities and ABAG have proposed for TODs located in the vicinity of BART stations, there is considerable risk that a well-meaning federal and regional policy will actually produce unintended outcomes, including more localized congestion and an unanticipatedly large increase in congestion-related emissions. This is most likely in East and South County because fewer of their TOD residents are likely to work in Oakland or San Francisco where parking is limited and costly. This, in turn, makes it likely that fewer East and South County TOD residents will use transit to get to work—even if they live in a Transit-Oriented Development. And, that is problematic because Alameda County freeways are already the most congested in the region, and any next increment of growth that produces a large next increment of traffic will produce a next increment of early-morning congestion and a related increase in fuel consumption and automotive emissions that includes both CO_2 and conventional tailpipe emissions.

This cascade of potentially adverse consequencees of future Alameda County population growth leads this author to a more cautious conclusion than that which informs present ABAG and MTC policy. Our conclusion is that Smart Growth can contribute to congestion management and emissions reduction, but the results are likely to vary substantially from location to location. In turn, a standardized approach to station-area density could produce negative impacts on congestion and emissions if a substantial share of future TOD residents own cars and work in a suburban setting where

parking is free and readily available. This, in turn, suggests that *caution should be the order of the day in terms of any standardized scaling of the desirable density of station-area development. Instead, the scale of development in each community should reflect a studied appraisal of likely future work-trip destinations and the likelihood that such trips can be made conveniently by transit.* In this regard, the work-trip destinations of present residents are the marker most likely to indicate whether a large-scale Smart Growth project in a given location can generate a significant increase in the use of transit and other commute alternatives—or whether it is more likely to increase demand on freeways and surface arterials already experiencing significant traffic congestion and already producing a significant volume of congestion-related emissions.

In other words, a discriminating approach to sizing transit-oriented developments is necessary to ensure that Smart Growth can make a constructive contribution to the reduction of CO2 and other automotive emissions. One size won't fit all.

Population growth, Smart Growth and congestion relief

If we hope to make the most of Smart Growth and reduce congestion at the same time we will have to "think outside the box." In this regard, we have much to learn from Canada, starting with its approach to the taxation of automotive fuels. More specifically: Canadian fuel taxes are about 50 cents higher than those in the United States. This $.50 difference turns out to be an accident of Canadian fiscal history, rather than the intentional outcome of Canadian transportation policy, but the result is instructive, nonetheless: Transit trips per capita are decidedly higher in Canadian cities than their closest-counterpart cities in the United States,

Table 5 below shows that Canada's four most-prominent transit markets produce 206 transit trips per capita each year on average, while their closest counterpart cities in the U.S. produce only 122 transit trips per capita, again on average.

Table 5: Transit Trips per Capita in Paired U.S. and Canadian Cities

Canadian Cities	U.S. Cities	Ratio of transit trips per capita
Toronto	New York	350:155
Montreal	Boston	222:114
Ottowa	San Francisco	135:112
Vancouver	Washington, D.C.	117:106
4-city average	4-city average	206:122

Source: J. R. Kenworthy and F. B. Laube, *An International Sourcebook of Automobile Dependence in Cities, 1960-2000*

Not all of the difference shown in Table 5 is directly attributable to higher fuel taxes. The severity of Canadian winters contains urban spawl and complicates winter driving, while higher rates of automobile ownership in the U.S. reflect higher U.S. incomes and more rapid U.S. motorization in the years immediately following World Wars I and II. But even allowing for these differences, the differences in Table 5 are large enough to suggest that the U.S. highway policies of the Interstate Era and the reservation of most gas-tax receipts for highway construcution contributed significantly to the relative intensity of U.S. motorization and the substantially lower level of U.S. transit use on a per capita basis. Conversely, higher fuel taxes, harsher winters, correspondingly more compact cities and no comparably aggressive federal commitment to freeway construction explain the higher transit use rates in Canada. The implication is that *Smart Growth offers only half a strategy for increasing transit use in a metropolitan area like the Bay Area. Canadian experience suggests that higher fuel taxes are the missing second half.*

Fuel surtaxes as a congestion management and emissions reduction strategy

Would California be prepared to consider something similar to Canada's fuel-tax policy? This author's guess is that no California Governor and very few legislators would even pause to consider a 50-cent increase in California's gas tax if it were proposed for the state as a whole. But, What if a 50-cent increase in the fuel tax was proposed only for the Bay Area and What if it was paired with an annual tax refund of $500 for every licensed driver in the Bay Area? For a median-income household this take-at-the-pump-and-give-back-at-tax-time policy would be close to a wash. It would also be a wash for the State treasury: The state would be taxing with one hand and giving back with the other. In terms of money in the bank, it would net out close to break-even for the state and for most middle-income households. Households with an SUV might come out a little behind, depending on their fuel economy and the mileage driven.

Why propose a tax swap? Because it's a potentially effective way to mitigate voter anger over a 50-cent increase in the gasoline tax—without significantly diminishing the felt incentive to conserve fuel, carpool, use transit, walk or bicycle more frequently. Higher fuel taxes would also provide the incentive to make one's next car a more fuel-efficient vehicle because every fill-up would be a reminder that "fuel costs more now."

Given this array of constructive responses to an increase in the fuel tax, most Bay Area residents should be able to find at least one fuel-conservation strategy that works for them, given their personal circumstances: Where they live, where they work and whether they have children to drop off at school on their way to work. And it is precisely this diversity of circumstances and conservation options that makes a fuel surtax a potentially effective strategy for reducing fuel consumption, automotive pollution and the contribution cars and trucks make to CO_2 emissions.

Most important for the longer term, is whether a 50-cent per gallon fuel surtax would have resonance beyond the Bay Area. If yes, it would motivate the energy and auto industries to accelerate the development of bio-fuels, purified hydrogen fuels and hydrogen fuel-cell vehicles. Automakers would also feel much greater urgency to bring

fuel-efficient vehicles to market—and every automaker would necessarily accelerate its efforts to go commercial with hydrogen fuel-cell vehicles, because no automaker could afford to be left behind. Transit, of course, would be first in line to benefit from higher ridership—but might be hard pressed to accommodate the additional peak-hour demand. Carpools and vanpools and more intense use of carpool lanes would pick up the slack—as they have with every oil shock. And, in this evolved context, living near a BART station might begin to sound like a good idea to a substantially larger share of the population.

A tax swap seems to offer a promising resolution for a vexing problem, but we are also well-aware that it would be no easy sale. The "first hump," of course, would be securing sufficient local consensus to achieve legislative authorization for both the 50-cent per gallon fuel-tax increase and the sales or income tax rebate of $500 for each licensed driver in the Bay Area. Even with a tax rebate, the imposition of a surtax on the price of gasoline may be perceived as too-much-too-soon and gain little or no traction. *But without some intervention of this sort, we should expect that transit's commute share in Alameda County will remain stuck in the range of 10.5 to 12.5 percent of all work trips. And, most likely, "other commute alternatives" will continue to lose ground in terms of commute share.*

This is the primary lesson to be learned from 45 years of building transit ridership and promoting carpooling in Alameda County, but making essentially no progress in increasing transit's commute share or the commute share of other commute alternatives. The lesson policymakers should take to heart is that *most of us won't reconsider and reevaluate our commuting, vehicle-purchase and location choices in the absence of higher gasoline prices, higher fuel taxes or paid parking.*

That, as I see it, is the unavoidable bottom line: A focus on Smart Growth and mode choice won't produce the results we need to simultaneously reduce congestion, CO_2 emissions and oil depletion—unless the price of gasoline gives us the additional push we need as fuel consumers and car buyers. With Smart Growth, policymakers can reasonably expect a one-and-a-half to two percentage-point increase in transit's commute share over 15 to 20 years—not much difference, given the expected increase in both congestion and CO_2 emissions.

On the other hand, with *both* Smart Growth *and* an increase in fuel taxes we could actually move the yard-markers—perhaps three to four percentage points in a single decade. That's a realistic estimate given the increases in both transit-use and carpooling that have occured each time tensions in the Middle East have produced a large and sustained spike in the price of gasoline. Remember, too, that the fuel-tax increase we are proposing would be paired with an income or sales-tax rebate, so the average middle-income household would come out whole. No increase in OPEC oil prices comes with this benign pairing.

In any case, what we now know about global warming indicates that we need to act more decisively to reduce the automobile's contribution to CO_2 and other greenhouse gas emissions. Smart Growth can help, but is not likely to produce much more than a one

percentage point increase in transit's market share in any one decade. Worth doing? Very much so. Do we need to do more sooner? Yes, we do.

Canadian experience suggests our best bet would be a fifty-cent increase in the gasoline tax—paired with the sweetener of an offsetting reduction in sales or income taxes. This life-long student of transportation policy and politics knows that a fuel-tax increase will be "No easy sale," but if Bay Area legislators can be persuaded to buy in, it would offer an energy-conservation and emissions-reduction strategy with the "oomph" necessary to make a difference. It would also give a significant additional push to the marketablity of condos and apartments located in transit-oriented developments. You can also bet that the world's automakers would take note—and reevaluate the competitive importance of increasing the fuel- and carbon-efficiency of the next generation of motor vehicles and motor-vehicle fuels.

But, it must also be emphasized that any increase in fuel taxes has to be paired with a reduction in sales or income taxes to avoid detriment to household buying power. That is essential—socially, economically and politically. Without such a pairing, there would be little possibility of majority support or legislative approval of any significant increase in fuel taxes (19). With such a pairing, the Bay Area would be equipped—for the first time—with a tool suited to the long and difficult task of actually reversing the automobile's contribution to global warming.

Glossary

Carpooling	Formal or informal ridesharing
Commute Share	The percentage share of commuters who use each mode of transportation for commuting to work
Congestion	Used here to describe recurrent delay during peak commute hours
Congestion-related emissions	Tailpipe emissions that result from stop-and-start driving in heavy traffic
Smart Growth	A growth-management strategy focused around rail transit investment, city-centered development of relatively high density, clustered residential development located in the immediate vicinity of suburban rail stations and the use of an urban limit line or growth boundary to contain suburban sprawl.
Transit	Public transportation by bus, rail or paratransit
Transit-oriented development	A housing or mixed-use development located adjacent to a BART, commuter rail or light rail station, transit-transfer center, or heavily-trafficed bus route.
Transit Village	Another term for a transit-oriented development.
Urban Limit Line	A growth boundary designed to contain suburban development either temporarily or permanently
Vanpooling	Ridesharing in a van or minivan

Notes

1. Texas Transportation Institute, *2006 Urban Mobility Study,* University of Texas, June, 2006.

2. Metropolitan Transportation Commission, , "Daily Freeway Delay by County, 2001-2005," *Bay Area Transportation: State of the System, 2006,* p.8.

3. Metropolitan Transportation Commission, "San Francisco Bay Area Vehicle Miles of Travel, 1990-2030," undated.

4. Bay Area Air Quality Management District, "Sources of Bay Area Pollutant Emissions for 2005: Mobile Source Emissions," 2006, p. 2.

5. Bay Area Air Quality Management District, "Source Inventory of Bay Area Greenhouse Gas Emissions," Table G: "Emission Trends by Major Sources," November, 2006, p. 10.

6. *Ibid.,* Table F, "Greenhous Gas Emissions by County, p. 8.

7. BART, Chronological file, 1947 to Present.

8. Bernard Grun, *The Timetables of History,* Simon and Schuster, 1991.

9. Charles Pervis, "San Francisco Bay Area 1990 Regional Travel Characteristics," Working Paper Number 4, MTC, December, 1994.

10. Author's calculation based on the Bay Area/Alameda County vehicle regisration file maintained and updated by Charles Pervis, MTC.

11. Nelson/Nygaard, "MTC's Resolution 3434 Transit Oriented Development Policy," July, 2006.

12. David W. Jones, "Oakland's Fruitvale Village: Its Transportation Benefits and Commercial Difficulties," August 2006.

13. San Jose is the wealthiest and most populous of the Bay Area's three "central cities," but also the least dense.

14. David W.Jones, *Mass Motorization and Mass Transit,* Indiana University Press, 2008. See also: McGuckin and Srinivason, "Journey to Work Trends in the United States and its Metropolitan Areas," Exhibit 1.1, U.S. DOT, 2003.

15. MTC, "Resolution 3434: Transit-Oriented Development Policy," July, 2005, p. 1-1. See also: MTC, "New Places, New Choices: Transit-Oriented Development in the Bay Area," November, 2006.

16. MTC, "Commuter Forecasts for the San Francisco Bay Area: 1990-2030," May, 2004, p. 13.

17. *Op. Cit., McGuckin and Srinivason,* Exhibit 1.1.

18. *Op. Cit.,* TTI, *2006 Urban Mobility Study.*

19. A lesson learned from Art Bauer and Dick Zettel, senior legislative consultants.